Mercury in Tomales Bay

Data & Statistical Analysis for Training Academy

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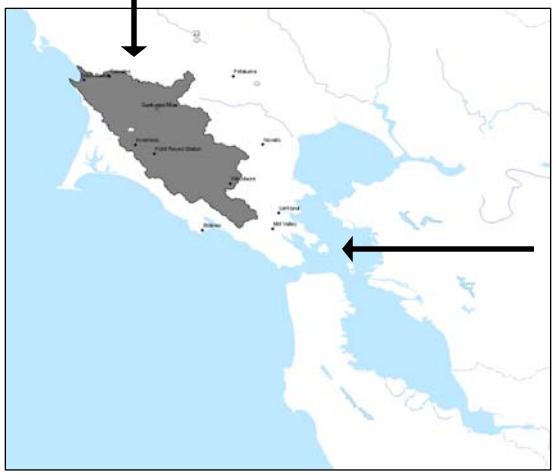
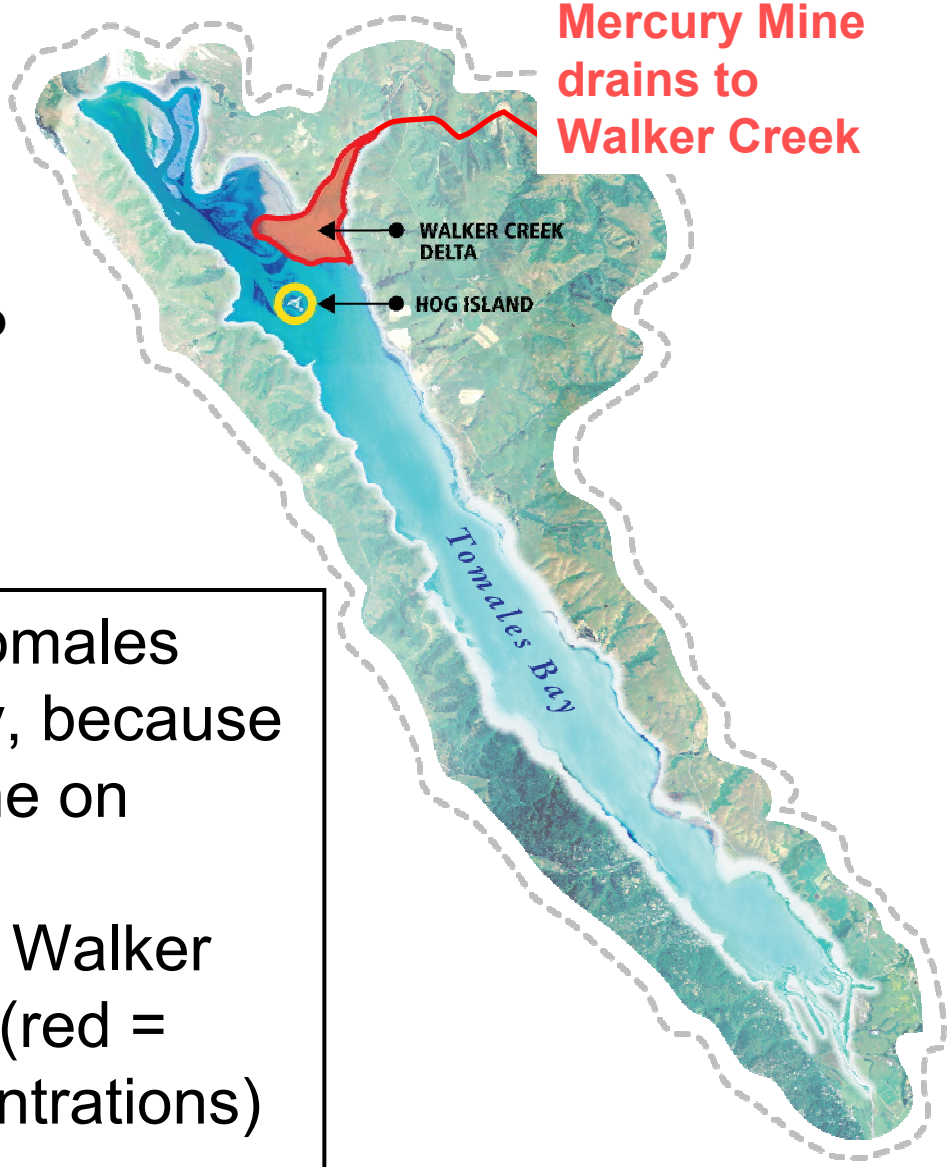
San Francisco Bay Regional Water Board

Tomales Bay watershed



San Francisco Bay

Gambonini Mercury Mine drains to Walker Creek



Good reason to believe Tomales Bay is polluted by mercury, because of Gambonini mercury mine on Walker Creek.
Data set is focused on the Walker Creek delta, shown in red (red = mercury & elevated concentrations)

Several previous studies

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Mercury accumulation and attenuation at a rapidly forming delta with a point source of mining waste

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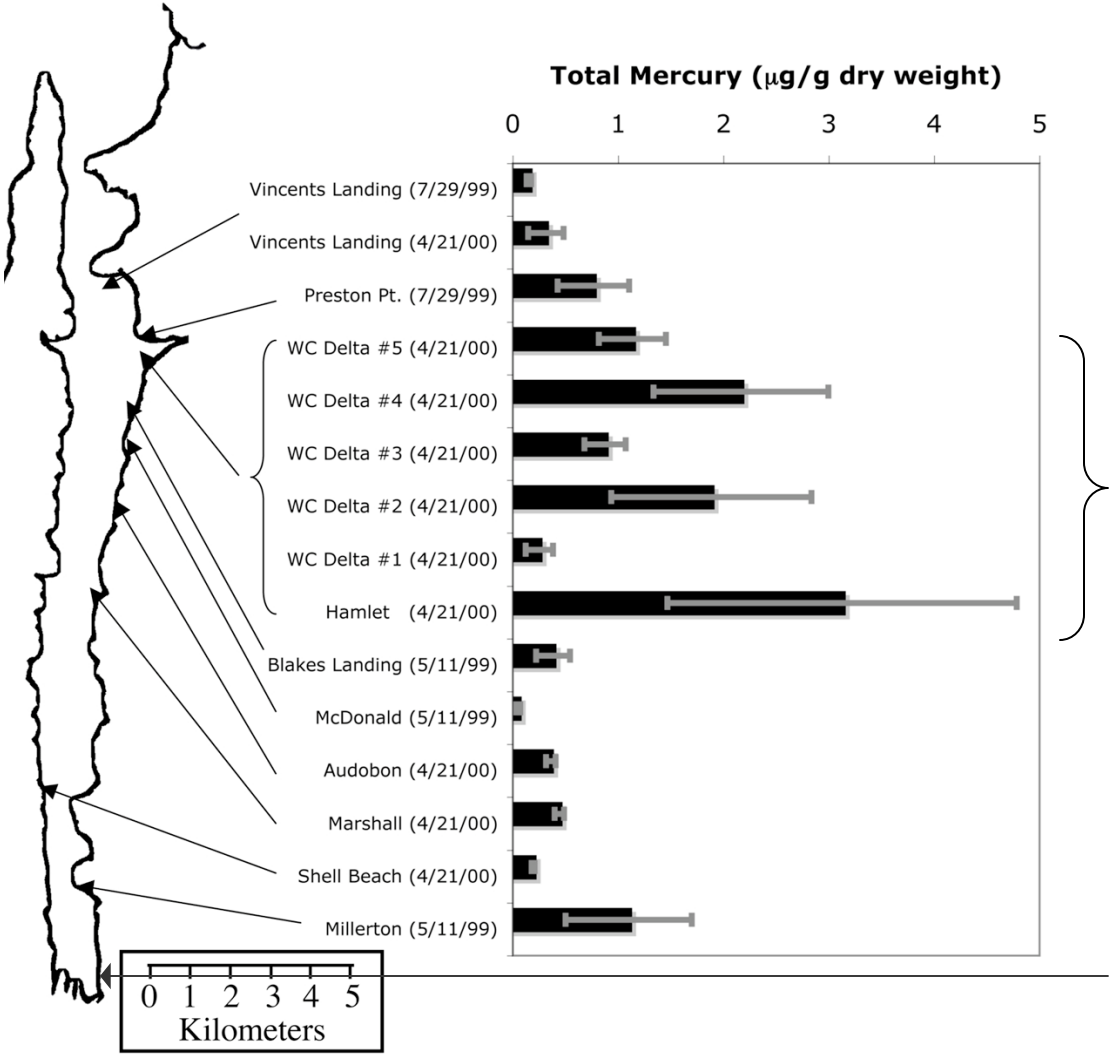
ABSTRACT

The Walker Creek intertidal delta of Tomales Bay, California is impacted by a former mercury mine within the watershed. Eleven short sediment cores (10 cm length) collected from the delta found monomethylmercury (MMHg) concentrations ranging from 0.3 to 11.4 ng/g (dry wt.), with lower concentrations occurring at the vegetated marsh and upstream channel locations. Algal mats common to the delta's sediment surface had MMHg concentrations ranging from 7.5 to 31.5 ng/g, and the top 1 cm of sediment directly under the mats had two times greater MMHg concentrations compared to adjacent locations without algal covering. Spatial trends in resident biota reflect enhanced MMHg uptake at the delta compared to other bay locations. Eighteen sediment cores, 1 to 2 m deep, collected from the 1.2 km^2 delta provide an estimate of a total mercury (Hg) inventory of 2500 ± 500 kg. Sediment Hg concentrations ranged from pre-mining background conditions of approximately 0.1 μg/g to a post-mining maximum of 5 μg/g. Sediment accumulation rates were determined from three sediment cores using measured differences of ^{137}Cs activity. We estimate a pre-mining Hg accumulation of less than 20 kg/yr, and a period of maximum Hg accumulation in the 1970s and 1980s with loading rates greater than 50 kg/yr, corresponding to the failure of a tailings dam at the mine site. At the time of sampling (2003) over 40 kg/yr of Hg was still accumulating at the delta, indicating limited recovery. We attribute observed spatial evolution of elevated Hg levels to ongoing inputs and sediment re-working, and estimate the inventory of the anthropogenic fraction of total Hg to be at least 1500 ± 300 kg. We suggest ongoing sediment inputs and methylation at the deltaic surface support enhanced mercury levels for resident biota and transfer to higher trophic levels throughout the Bay.

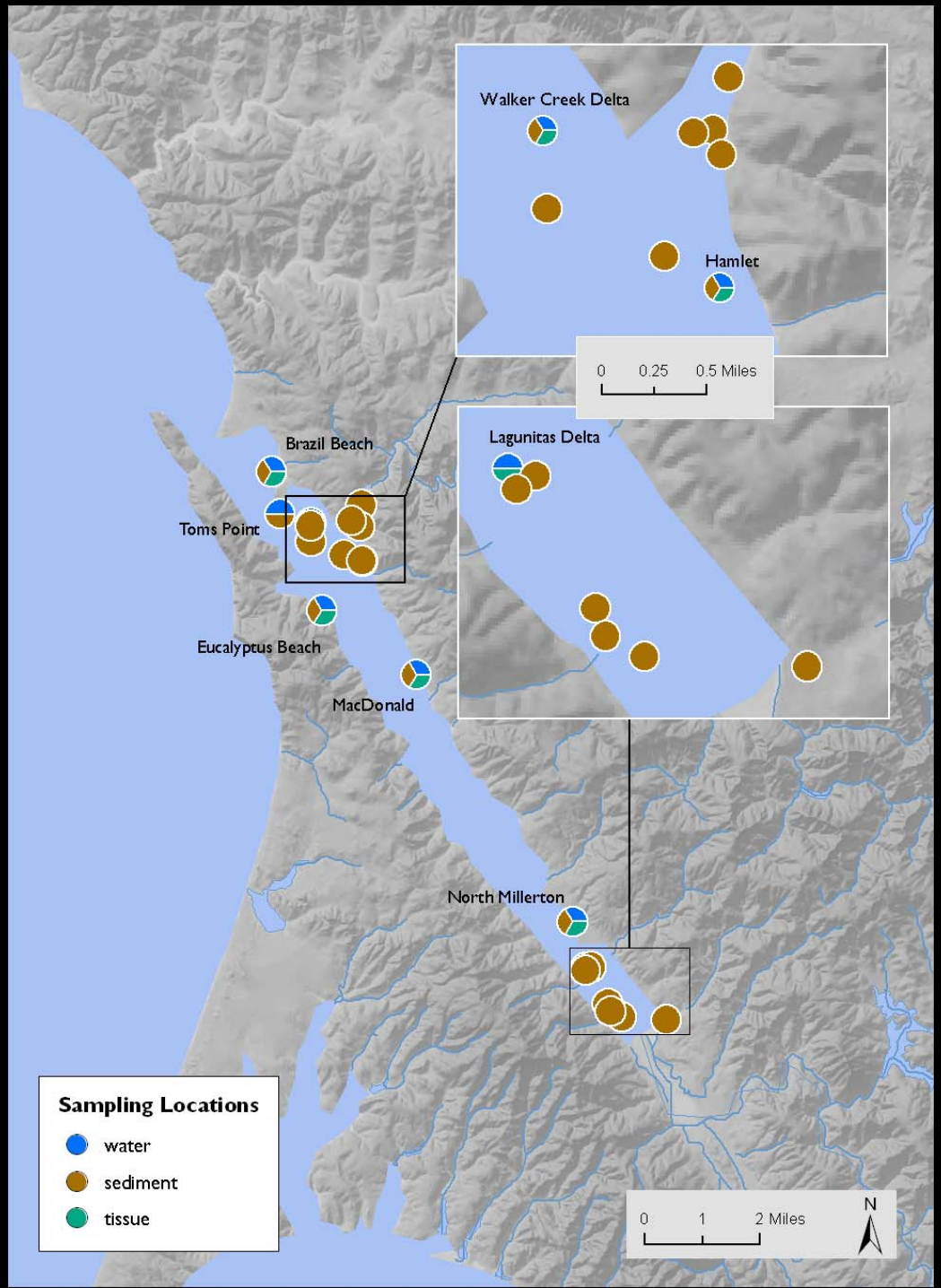


Highest sediment [mercury] Walker Creek delta

Except here

and no data here

Average surface sediment (upper 5 cm) mercury
Error bars are two times the standard deviation.
3 to 5 samples per location.



We focused our sediment sampling (brown) at opposite ends of Tomales Bay, shown in these insets, at Walker & Lagunitas deltas, expecting them to be most different (and most biologically important)

Sediment Sampling

PLAN

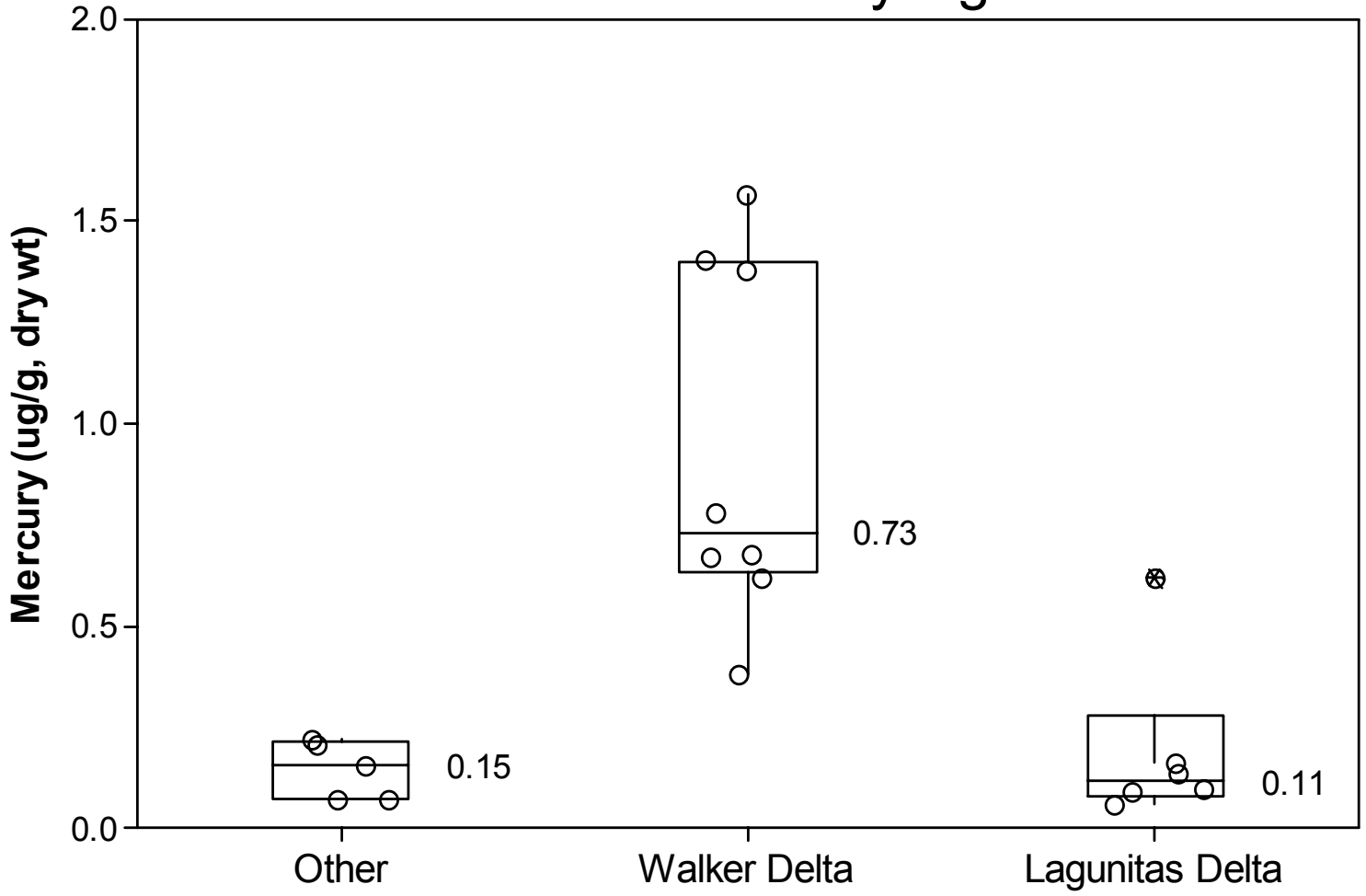
- *n* = 8 for each of Walker Creek delta and Lagunitas Creek delta at head of bay, additional samples from along the bay
- Each sample composited in field from 4 locations 1 meter apart
- Each delta sample collected in replicate within 100 meters (submitted individually to lab, then average results)

REALITY

- field error, n = 6, not 8, at Lagunitas

Total mercury in sediment (2009)

Walker Creek delta is obviously different, and
"other" is similar to Lagunitas Creek delta
Is the difference statistically significant?



ACTIVITY:

Compare total mercury in sediment from Walker Creek delta to "other" and "Lagunitas Creek delta" sites combined

- Import dataset (comma separators):

www.ics.uci.edu/~jutts/data/WalkerDelta.txt

- Recode variables, give new name, use "Lagunitas Delta" = "other"
- Do boxplots (by groups) of mercury
- Do independent sample t-test to compare mercury; look at CI for difference.
- Create new variable: log(mercury) and repeat.